

LANPHEAR (E.)

AMERICAN JOURNAL
OF
SURGERY AND GYNÆCOLOGY,

PUBLISHED MONTHLY BY THE

AM. JOURNAL PUBLISHING CO., 1309 EAST 8TH ST., KANSAS CITY, MO.

PRICE, \$1.00 PER ANNUM IN ADVANCE.

VOL. II.

JANUARY, 1892.

NO. 6.

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WHAT CAN BE DONE IN CEREBRAL SURGERY—REMARKS
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To those unfamiliar with recent advances in the surgery of the brain my paper may be something of a surprise, because of the radical changes which have occurred in this department of operative surgery within the past few years; in fact I doubt not there are some who will contend that we are too aggressive—that we invade the cranium with too much impunity. But from a careful study of twenty-three cases, operated upon by myself (a series of cases presenting two deaths and twenty-one recoveries) and a review of recent contributions to the literature of the subject, I firmly believe that we have not yet awakened to the possibilities of operative surgery in diseases of the nervous system. Bremer, of St. Louis, says¹: “Owing to the comparative safety which is afforded by asepsis, many more skulls are opened than the status of our knowledge of the brain, its physiology and pathology, warrant.” Perhaps in its broadest sense this is correct, but the opposite position is equally tenable; in proportion to our knowledge of localizing symptoms *not enough* skulls are opened—in appropriate diseases.

For what can we operate?

1. Meningeal hæmorrhage.
2. Cerebral hæmorrhage.
3. Tumors of bone, meninges or brain.
4. Cerebral abscess and thrombosis of lateral sinus.
5. Cephalalgia.
6. Epilepsy.
7. Insanity.
8. Tuberculosis.
9. Microcephalus.

*Read before the Academy of Medicine, Nov. 28, 1891.

Operation for gunshot wounds, fractures, etc., is foreign to this paper, it belonging to accidental surgery.

MENINGEAL HÆMORRHAGE.

Of the practicability and necessity of operation in meningeal hæmorrhage there can be no question; since Macewen, in 1879, opened the skull of a boy and removed two ounces of fluid and coagulated blood from beneath the dura in the lower part of the Rolandic fissure, with recovery, cases have been too numerous and results too satisfactory to admit of discussion. By the term meningeal hæmorrhage I include hæmorrhage between the bone and dura mater and bleeding into the subdural or subarachnoid space. Usually this condition is the result of injury, so there is no doubt as to the diagnosis in most cases—the injury being most frequently a rupture of the middle meningeal artery or its anterior branch. The symptoms may occur rapidly, but more often they appear gradually, the bleeding taking place slowly and continuing until either the tension or coagulation closes the vessels or fatal compression is induced. In a typical case the patient is stunned for some time, but gradually regains consciousness; after an interval of from a half hour to a day or two, symptoms of compression make their appearance. In such cases trephining is always indicated. If one meets a case of non-traumatic origin the diagnosis rests between meningeal hæmorrhage and embolic or thrombotic softening—a distinction not always possible to make. In such an instance the patient should be given the benefit of the doubt.

When the intracranial hæmorrhage is due to injury, the external wound indicates the site for operative procedures. If there be no external guide, dependence must be had upon localizing signs, the broad rule always being borne in mind that for hæmorrhage from the anterior branch of the middle meningeal artery the point of selection (unless very strongly contraindicated) is one and one-fourth inches behind the external angular process; while for the posterior branch the point is a little below the parietal eminence. As soon as a diagnosis of meningeal hæmorrhage is established the surgeon should open the cranium under strictest asepticism, remove the clot, thoroughly irrigate with water of a temperature of 110° F., put in a catgut drain, sew the dura with finest catgut sutures and close the incision in the scalp with proper drainage, dressing as any other wound. The drainage tube may be removed on the second or third day. Small strips of iodoform gauze may be employed for drainage if so desired; they have given satisfaction in several of my cases.

The last operation* for meningeal hæmorrhage in this city was by

*NOTE.—Since writing this paper I have operated in a case with Drs. Adams and Von Quast in which there was not the slightest abrasion of the scalp discoverable even when shaved, yet upon turning back the flap a fracture was found crossing the track of the middle meningeal artery. Upon opening the skull the artery was discovered torn through; it was caught without difficulty, the hæmorrhage checked and a clot as large as an orange removed, extra-dural. How the injury occurred is a mystery.

Dr. J. W. Perkins.² A boy received a blow over the anterior branch of the middle meningeal artery; evidence of compression including hemiplegia came in due time; four hours later Dr. Perkins trephined and found a clot considerably larger than an English walnut; this was removed, the bleeding vessel attended to, the wound irrigated and closed; recovery was uninterrupted and complete.

CEREBRAL HÆMORRHAGE.

Under the head of cerebral hæmorrhage I include bleeding in the substance of the brain or into the cavity of the ventricles. Until within a very short time these cases have been believed to be beyond the pale of surgical interference. Indeed Horsley, one of the boldest of cerebral operators, as late as July, 1890, advises³ tying the common carotid artery in every case of bad cerebral hæmorrhage seen within four hours after the attack; to the universal adoption of which I must protest, and I note that Krönlein, of Zurich, says⁴ it must be restricted in its general applicability. Osler, of Johns Hopkins Hospital, Baltimore, also condemns⁵ any attempt at surgical correction of the trouble except in cases of traumatic origin. In fact, the only authority (in the English language) that I can find encouraging operative measures is Landon Carter Gray, of New York, who states:⁶ "In cases (other than ganglionic) thus far reported the lesion has been in the external capsule, between the lenticular nucleus and the cortex. Alcohol, insanity and trauma are ætiologically related to cortical and dural hæmorrhages, while syphilis, chronic Bright's disease and cardiac hypertrophy affect principally the basal and central vessels. As regards the type known as ingravescens or progressive apoplexy, the author rather inclines to the trephine as a means of possible relief. This must be done before the blood breaks into the ventricles. To reach a hæmorrhage in these cases the best place to trephine, as Dana suggests, would be a little below and in front of the parietal eminence. To reach the internal capsule in its anterior and middle parts he recommends that a point be located half way between the anterior and posterior ends of the corpus striatum and optic thalamus respectively." Almost every work explicitly advises against operation. Thus Starr, of New York, says⁷: "It is in cases of cortical or surface hæmorrhages only that operations can be done. If the clot be upon the external surface of the hemisphere and produces symptoms of aphasia, hemiplegia or hemianopsia, it can be removed." The reason he assigns for objection in subcortical hæmorrhage is that "when a hæmorrhage has occurred within the cerebral hemisphere, lacerating the tracts and destroying tissue, operative interference is out of the question; for tissue once destroyed in the brain is not repaired by Nature, and even were repair possible, the surgeon could not reach and remove the clot without producing a further laceration of very important cerebral structures or serious cerebral hæmorrhage." To this I must enter a demurrer. In the first place in cerebral hæmorrhage the tissues are often

simply *pushed apart* without serious laceration of the tracts or destruction of tissue (*except by pressure necrosis*)—so if the clot be removed early permanent injury may be prevented; in the second place the surgeon *may* cut the white matter of the brain to a very considerable extent without pronounced harm resulting; I have many times freely incised the brain tissue without serious consequences, and in gunshot and other wounds extensive injury has often been noted with no particular symptoms arising; and in the third place the surgeon can readily control any bleeding which he may cause—so upon the whole I regard his position not well taken.

In 1883 Macéwen, in a case of extravasation of blood into the white substance of the motor tracts, where the clot was located by the symptoms present, operated and removed the clot with recovery of patient. Since that time a few operations have been made. Lucas Champonnière not long since reported to the Académie de Médecine^s a case of trephining for cerebral hæmorrhage: A man, aged 53, had an attack of cerebral hæmorrhage, the focus of disturbance being localized at the middle part of the precentral convolution; upon operation the remains of an old clot were found and removed and the hemiplegia and aphasia disappeared. Champonnière has been able to collect statistics of thirty such cases, all of which were nontraumatic in origin—with no death and no untoward occurrences. Encouraged by this success, in spite of the condemnation of authorities, I have operated once for cerebral hæmorrhage not traumatic.

Case.—Dr. W. C. B.—age forty-seven, had a slight attack of cerebral hæmorrhage in early part of 1891, from which he entirely recovered. I saw him at Carthage, Mo., Oct. 10, 1891, in consultation with Dr. R. T. Scott. The following is the entry in my case book: "Patient had 'stroke of paralysis' about two weeks ago; had all the symptoms of cerebral hæmorrhage; has not entirely regained consciousness since; has right hemiplegia and complete aphasia; has been rapidly emaciating; has lately had paralysis of bladder, dysphagia and fever, (temperature 100° to 101° F.); strength rapidly failing—to an alarming degree past few days; indicates that he has terrible pain and tightness in head, with insomnia therefrom. At 3 p. m., assisted by Drs. Matthews, Scott, King and Schafer, I opened skull over motor and speech centers; no pulsation of dura; on opening dura, found some softening of arm center; enlarged fenestrum and examined speech center; no evidence of clot there, but indications of severe pressure. Removed remnants of clot (sub-cortical) and some of softened arm center, irrigated with hot bichloride solution—1 to 5000—put in catgut drainage and closed. Duration, 1 hour and 35 minutes. Put to bed in good shape, with little shock. Pulsation of brain returned (at opening in skull) after operation.

"Oct. 11. Slept finely all night on morphine (gr. $\frac{1}{4}$) and atropine (gr. 1-60). At 9 a. m. is feeling first rate—better than at any previous time; mind much improved; can say 'oh, yes,' quite distinctly, and can move foot to marked extent. At 4 p. m. dressed wound and removed drainage; applied large quantity of iodoform and put on permanent dressing."

The subsequent history is given by Dr. Scott thus: "Three hours after our redressing the wound the temperature dropped from 100 $\frac{1}{4}$ to 99.3-5. On the following day (Oct. 13), temp. 99, pulse 110, stomach irritable; applied mustard and

ordered milk and lime-water in small quantities frequently repeated. At 4 p. m. temp. $100\frac{1}{2}$, pulse 110 and intermittent; patient restless; gave sulfonal \mathfrak{D} ss, in milk, repeated in two hours; also hydrargyri protiodid, gr. $\frac{1}{4}$ every two hours until bowels move. Oct. 14, 9 a. m., temperature normal, pulse 100 and regular, appetite good; can urinate without catheter. At 7 p. m., temperature normal, bowels acted freely from mercury; having slept well the night before, sulfonal was repeated. Oct. 15, condition improving. Oct. 20, on removing dressings found head as dry and clean as when first applied; wound healed by immediate union. Patient is able to sit up several hours each day, and is entirely free from headache he had prior to operation."

The patient came to Kansas City (203 miles from Carthage) on Oct. 30. The amount of improvement was so great as to actually shock me. And a letter written Nov. 24, by Dr. Scott, says: "Dr. B. is still improving."

Comment is unnecessary.

BRAIN TUMOR.

Operation for brain tumor is certainly an inviting one—the result from the expectant plan being invariably fatal, generally within two years; the wonderful changes sometimes apparently wrought by internal medication, are deceptive, but do not prolong life; in most instances the growth can be readily localized; and in a large proportion of cases it is within reach of the surgeon's knife. While it is probably true, as Agnew says,⁹ that "the results of operations for extirpation of brain tumors cannot be considered as particularly brilliant," from the few cases I have seen and from the excellent results obtained by Macewen of Glasgow and Carson of St. Louis,¹⁰ as well as others, I must agree with the statement of Clarence Bartlett, of Philadelphia,¹¹ that "in the absence of any reliable cure of brain tumor, one is not justified in waiting long for results if the symptoms are such as to enable him to locate the lesion accurately." As to this question of location, according to M. Allen Starr,¹² about one-third of all cases occur in the basal ganglia, internal capsule, corpora quadrigemina, crura, pons and medulla and so are inoperable. Of the remaining two-thirds a considerable percentage must be amenable to surgical treatment. Even though the tumor may not be found, a large trephine hole may afford much relief if the button be not replaced, as in a case reported by Fischer, of Breslau,¹³ and also in a case of double trephining by Kocher,¹² to relieve symptoms when localization was impossible, the only pronounced features being choked disks, deterioration of vision, headache and unsteady gait; an opening was made anteriorly in the frontal region, with some bulging of the dura, and one posteriorly just below the tentorium cerebelli, where a hernia cerebri formed which was removed with a Volkmann's sharp spoon and the wound closed; union by first intention was secured; four days after operation the congestion of the disks had entirely disappeared and sight had improved; seven weeks after operation the general condition was much better, sight the same, the gait steadier and the headache gone.

If the tumor can be located, I believe the indications are to remove it, if possible—even though it gives but temporary relief. Some cases

have been certainly *cured*, and the cerebral functions, strange as it may seem, restored after removal of even very large intracranial growths. Thus in a report by H. H. Mudd, of St. Louis,¹⁴ an immense echinococcus mass was removed from the brain of a girl of 12 years, it being larger than a hen's egg and located in the motor region, reaching from the convexity to the lateral ventricle; after shelling out the tumor the wound was treated in the usual manner; the hole, large as it was, closed up and the motor disturbances disappeared, viz.: tremor and hemiparesis accompanied by hemianopsia and choked disk. Bremer explains¹⁴ restoration after such colossal defect by the assumption "that the fibers of the corona radiata, in which the tumor laid, were not destroyed but merely pushed asunder; that though perhaps the myeline sheaths of these fibers were atrophied by pressure, the more resisting axis cylinders had preserved their continuity, and that complete regeneration took place."

VARIETIES.—The great majority of brain tumors are either syphilitic or tubercular—occurring as gummata or caseous masses respectively, the latter chiefly in young subjects. Other forms of tumor more rarely met, are osteomata, sarcomata, fibromata, gliomata, carcinomata and cysts. Tumors other than those mentioned (very rare) are cysts of the arachnoid, hydatids, plexiform angio-sarcomata, endotheliomata, etc.

Gliomata.—These growths, if not very vascular, may be easily removed. They are almost always found in the gray matter. If thoroughly extirpated, recurrence is not probable, and *all* symptoms may disappear. Thus P. Postemski, of Rome, on May 24, exhibited to the Royal Medical Academy at Rome¹⁵ a case upon which he had successfully operated some months before; all of the symptoms were gone and the woman was (apparently) completely restored to health.

Fibromata.—Fibromata spring from the meninges, are therefore easily accessible and readily subjected to extirpation. In the few cases I have been able to discover in recent literature success has been the result invariably.

Carcinomata.—Carcinomata are not frequently met in the brain; they are attended with just as great danger of return after removal as in any other part of the body. They commonly have a mass of hyperæmic and softened brain matter around the morbid growth, but in spite of this may be cut away, the adjacent tissue being cleaned out with a cutting Paquelin cautery.

Cysts.—Cysts are comparatively rare. They can ordinarily be removed without difficulty, though in a case in the practice of Dr. John Panton, of this city, operated upon by myself, there was not sufficient integrity to the cyst wall to allow of removal, had such been our intention; the cyst was simply opened and a drainage tube inserted. Experience has shown that cysts opened and drained give almost as good results as cerebral abscess.

Gummata.—Of these Horsley remarks: "Cerebral gummata should

be removed—iodide of potassium palliates, but does not cure them," a statement in which all who have studied the subject must concur. The assertion of Agnew¹⁶ may be taken as especially applicable to this class of cases: "The triumph already achieved by the conjoined labors of the neurologist and surgeon may be the harbingers of still greater ones in the future."

Sarcomata.—Sarcomata found in the head are either of the spindle-celled or myeloid varieties. They may spring from the diploë, widely separating the tables and at last breaking through with much suffering, especially if the growth be directed inward. In most instances they develop in the dura mater; the question of extirpation in such cases is of vital importance, and still undecided. They frequently perforate the cranium and spread beneath the scalp, in which instance there is usually a distinct pulsation in the mass, reducibility when small, and a characteristic sharp opening in the skull. I believe excision to be the correct thing, as Mansell Moulin maintains;¹⁷ the only question which arises in my mind is justifiability in advanced cases. Increasing experience in cerebral operations and (especially) observation of several cases of extensive destruction of the dura in St. Margaret's hospital in this city (under Dr. Perkins) lead me to the conclusion that we may remove a much larger portion of the dura than we have been wont to believe. I have removed an area $2\frac{1}{2}$ by $3\frac{1}{2}$ inches without apparent ill effect so far as cerebration is concerned. If the scalp and periosteum be brought over the hole so as to completely close it the brain gets on very well—in certain parts at least. In view of which I am strongly of the opinion that operation for sarcomata might be successful in more cases than now reported were surgeons less saving of the dura; and even should permanent paralysis result from interfering with motor areas such a termination is far better than death from the neoplasm.

Osteomata.—Those concerning us in our study of cerebral surgery are of the inner tables or diploë (enostoses). As a rule they are of slow growth and may be left alone; but if serious symptoms arise, as displacement of the eyeball from osteoma of the frontal sinus or indications of intra-cranial pressure, they must be removed. A case in point is as follows:

* *Case.*—Dr. W., aged about 35, first came under my care in the summer of 1889. He was then affected with aphasia and hemiplegia, of supposed syphilitic origin. There was considerable improvement after he had taken several drachms of mercury (red iodide), and some three pounds of iodide of potassium, with Faradism for the paralysis, and in the autumn of 1889 I accompanied him to his home in Fairport, N. Y., and gave him into the hands of the trusted family physician, who continued the treatment. February 5, 1891, he made his appearance at my office, saying he had come from New York for the purpose of having craniotomy made. I therefore placed him in the hospital for operation. My record made at this time states that "aphasia has greatly improved; disposition has changed so that patient is irritable, irascible, and emotional, crying and laughing on slightest provocation; at present there is partial paralysis of entire side and complete of forearm; com-

plaints of constant priapism and constipation. Seems to be almost an imbecile at times; at others is quite rational but very emotional; most time passes urine in bed unconsciously, always unless drawn with catheter; has peculiar spasms of throat at times. Is very vulgar and obscene in language and careless in personal habits." On February 24, assisted by Drs. Richd. Callaghan and J. W. Kyger, I opened the head with mallet and gouge over supposed site of trouble, removing the large piece of the skull here exhibited; the opening was a little too far back as at the anterior part only the bone was found greatly thickened and eburnated—in fact the bony tumor pressing down upon the frontal convolutions was so hard that my large Rongeur forceps were broken in attempting to remove the growth, and the ivory-like tissue had to be cut away with carpenter's chisel and another forceps. The opening thus made measured about $1\frac{1}{2}$ by $3\frac{1}{2}$ inches.

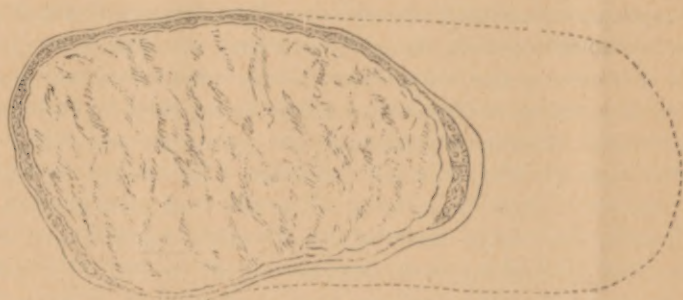


Fig. 1.

FIG. 1.—In this cut the black line shows size of piece removed by chisel; dotted line that cut away with Rongeur—actual size.

This osteomatous tumor was of somewhat irregular shape, but quite smooth upon its surface; the pressure was such as to cause much bulging of brain into opening before the mass was taken away.



Fig. 2.

FIG. 2.—This cut shows vertical section of bony tumor removed—actual size.

Examination of the brain gave negative results. The remnants of dura were sutured without drainage, but a small rubber tube was put through the scalp and wound in the scalp and periosteum closed with cat gut sutures. Patient put to bed in good condition.

Next day patient was much brighter, called for urinal instead of wetting the bed; no fever; in the evening went to closet for movement of bowels. On the morning of the second day patient insisted upon dressing and going about ward as before operation; this he did daily with no apparent harm. The drain was removed on the third day; wound healed nicely by primary union; there never was an untoward symptom.

About the first of April he was discharged; there was great improvement in mental condition; rectal and vesical troubles were gone; difficulty in talking and deglutition had entirely disappeared; emotional disturbances had ceased; but paralysis remained unchanged. He was advised to go to some watering place and to use electricity for the paralysis, but unfortunately while *en route* to Waukesha he took too large a dose of morphine and abruptly terminated the case history. I believe that he ultimately would have entirely recovered because the electro-muscular contractibility was not lost, though almost absent in the forearm.

Cerebellar tumors (presenting symptoms of vertigo, vomiting, tenderness over the occiput, cerebellar ataxia and paralysis of the fourth nerve) have proven bad cases for removal. In a dispensary case which came under the joint treatment of Dr. F. B. Tiffany and myself, we made a diagnosis of tumor at origin of middle cerebellar peduncle of the left side; exploratory operation was offered and refused; death was sudden; the autopsy confirmed the accuracy of our diagnosis, but showed that an operation would have been unsuccessful as the growth extended downward until it implicated the fourth ventricle.

ABSCCESS.

Abscess of the brain, from a surgical standpoint, is more favorable than tumor. The rule now is to operate always—death is certain; relief is sure if operation be made early enough; the mortality is very slight—three out of seventeen cases collected by Von Bergmann—as compared with 100% mortality without operation. This condition may be the result of traumatism even when the skin has not been injured nor the bone fractured (Mansell Moulin). The suppuration may be either diffuse (acute cerebritis running on to suppuration and proving fatal within a few days) or circumscribed, the area of red softening growing more and more liquid in its center until it simply becomes a collection of pus. In this instance the pyogenic organisms are carried to the site of injury by the blood. The abscess might be due to impaction of pyogenic emboli from some distant focus of suppuration, as the lung, in which instance it would probably be located near some terminal twig of the middle cerebral artery. In most instances it is traceable to suppuration near by, as from injury or disease of bone. Of the latter we see a typical case in abscess accompanying inflammation of the mastoid cells and in otitis media suppurativa.

But, whatever the cause, as intracranial suppuration if left to itself is practically hopeless, the indications are always to open the skull, evacuate the pus, irrigate the abscess cavity and establish free drainage. So essential is this that when the dura is opened at the supposed seat of abscess and no pus is found, an aspirating needle may be thrust into the brain in all directions until the pus is located. I have often used a large needle in this way (even withdrawing some fluid from the ventricles) without apparent harm to the brain. Great care must be exercised not to practice this extensive exploratory work in those doubtful cases which, instead of being cerebral abscess, are thrombosis of the lateral sinus or

pyæmia from middle ear disease—conditions which closely simulate abscess in their clinical picture. Here the mastoid antrum must be explored first and free communication established with the external auditory meatus, by thus doing many cases of inoperant meningitis might be averted. But if no pus is found, exploratory trephining must be made either half an inch above and somewhat in front of the meatus to explore the anterior surface of the petrous bone, or just behind the meatus and on the same level. It is best perhaps to first expose the orifice of the mastoid vein, and if no evidence of thrombosis be found, to then make the opening in front, exposing the under surface of the temporo-sphenoidal lobe where the abscess is often located.

"If no abscess is found in the anterior operation, either between the dura mater and the bone, or in the substance of the brain, and there is no evidence of thrombosis even when the mastoid vein is exposed, the periosteum and muscular attachments must be separated from the occipital bone beneath the superior curved line and the lateral lobe of the cerebellum be explored. In many cases of cerebellar abscess, however, there is sinus thrombosis as well and there must always be considerable danger of one of the two being overlooked if the other is found. If extra-dural abscess or thrombosis of the lateral sinus are found, the jugular vein should at once be ligatured. The only hope lies in thoroughly cleansing out the clot and removing the whole focus of the disease."¹⁸

"Localization in this class of cases, as a rule, is not difficult when once the history of suppuration of the middle ear has been established. The temporal lobe or the cerebellum on the same side with the ear disease are the usual seats of these abscesses."¹⁹ This rule should not be ignored, even when some localizing symptoms and history point to other regions as well, as in the case of Charles D.—to be presently mentioned.

Abscesses are quite often not single. Kidd reports²⁰ a case of double abscess; the trephine was used in the frontal region and pus evacuated. From an abscess the patient died on the fourth day and the *post-mortem* revealed a second and larger abscess in the temporo-sphenoidal lobe of the right side *without* (a rarity, indeed) disease of the petrous portion of the temporal bone, the cause of the frontal softening was a recent kick of a horse; that of the posterior abscess was unknown, it usually being due to ear-disease, and often existing for months or years. A case almost precisely similar was lately operated upon by myself.

Case—Chas. D—, aged 32, patient of Drs. Kestler and Mosher, received a blow upon the right side of the head by a cable-car on the night of Sept. 18, 1891. He was stunned for a little time, but recovered and went about next morning, though his employer noticed he acted strangely—"dazed." This condition continued until about Oct. 11, 1891, when he had to go to bed because of the increasing headache, especially marked at the junction of the parietal and occipital bones of the right side. He developed fever, had a severe general convulsion, remitted intermittently at irregular intervals, and finally became delirious and semi-comatose. I first saw him

Oct. 18, in consultation with the doctors, but as there appeared to be marked amelioration of his symptoms it was decided that an operation should be deferred. He soon again became worse and continued to decline until the 23d. At 2 p. m. the doctors determined to have the operation made, and at 4 p. m. arrangements were completed; but at that hour patient was in profound collapse, pulse weak and intermittent, extremities cold, eyes strongly turned to the left and insensible to light. Operation was, therefore, again postponed, stimulants being used vigorously. At 9 o'clock, Oct. 25, we again met, Drs. C. D. McDonald and E. W. Myers being also present.

Upon opening the skull (about one and one-half inches behind and a little above the external meatus of the right side) the dura bulged prominently into the hole, and was entirely without pulsation. On turning back the dura a large area of softened brain tissue presented, not yet broken down into pus—there being only a little spot of complete fluidification; this was scooped away and the surrounding red softening curetted with a sharp spoon and touched with a Paquelin cautery. A needle was now thrust in two or three directions without finding pus, but indicating quite extensive softening; this was very apparent to the touch of the finger also. After irrigation a drainage tube was inserted and the usual dressings applied. There seemed to be a slight improvement that day, in his mental condition, but he suffered considerably from shock. On the evening of Oct. 27, we dressed the wound; upon opening it up about one and one-fourth ounces of pus and broken down brain matter were discharged. Dressings were re-applied, and patient made easy, but he continued to sink and died next morning from shock and exhaustion.

The autopsy showed another abscess, evidently of months standing, in the left side, due to caries of the petrous bone. While this had existed for a long time the only evidence presented *ante mortem* was a chronic discharge from the middle ear and an occasional sharp pain in the occipital region on left side. Death, in my opinion, was due to the recent abscess for which operation was made, though the concussion producing it may have set up trouble at the old focal lesion. Sooner or later, however, the latter would undoubtedly have caused death, if not recognized and emptied.

In connection with the subject of abscess it is of interest to note that Orlow has reported⁴¹ the history of a woman, aged 27, who was affected with suppurating thrombosis of the lateral sinus, diagnosticated by symptoms and successfully treated by trephining. Prof. Briggs, (C. S.) of Nashville, has had a somewhat similar case; operation for sinus thrombosis is quite common in mastoid disease.

CEPHALALGIA.

Although it may seem rash to advise opening the skull for a thing apparently so simple as headache, there are certain cases of cephalalgia which resist all therapeutic measures; where such prove persistent and intractable, trephining should not be forgotten. Keen has operated once for intense headache following a blow with complete relief of pain. Agnew⁴² reports two cases of persistent headache not relieved by medical treatment, one cured and one improved. Martin, of Philadelphia, is quoted by Agnew as having had a cure following operation for headache. Horsley has operated four times with four cures; Prewitt, of St. Louis, twice, with like result, and a number of other operators have had similar success.

In one case of almost unbearable headache which came under my own care in 1890, trephining completely relieved the distress, and permanently. I believe Victor Horsley is correct in advising that trephining be done in all headaches which prove refractory to other measures. Especially is this true of localized headaches and also when the pain seems to be the result of an old injury.

INSANITY.

The suggestion to open the skull in insanity is not new, but its execution is recent. Burckhardt²² has detailed six cases of insanity with marked hallucinations, which he subjected to operative treatment. "In two cases he aimed to intersect the paths of association, which he thinks transmits the pathological impression coming from sensory parts and certain ideogenic areas of the brain; a portion of the frontal and parietal lobes, before and behind the ascending convolutions, were removed with very satisfactory results in one case, the other being still under treatment. In the other four cases the hallucinations were more or less acute and in these cases the operator attacked the centers through whose injury sensory and motor aphasia are produced, and removed a part of the first temporal and third frontal on the left side, which appeared diseased and with satisfactory results. It is possible that with additional experience and a minute study of the pathological changes seen in the brain, the knife may be the means of restoring to reason many cases now considered incurable." But the question naturally arises—were or were not these cases the result of the operation *per se*? Only further experimentation and careful observation can determine. It is in the first stage of general paresis that I shall look for beneficial results, for here we have a mental disease (so-called) which is dependent upon gross lesions. In insanity due to intracranial growths the indications are always to operate.

EPILEPSY.

The question as to the propriety of operating for epilepsy, traumatic or otherwise, has been much discussed; there certainly appears to be much to base hopes upon, but results have not been altogether satisfactory—in fact while there have been some very brilliant cures, especially when due to trauma, no improvement has been secured in a large proportion of cases. Personally I have operated but once—a dismal failure. But I am persuaded to try it again by reading reports, such as that of Péan.²³ Patient for years suffered from inherited epilepsy, not traumatic; internal medication failed; there was no localizing symptom save pain, but an operation was made at the seat of pain and an angioma removed from the meninges, and implicating the superior longitudinal sinus; cure has been complete and unquestioned.

Victor Horsley is a strong advocate of trephining for epilepsy, but upon the other hand White,²⁴ of Philadelphia, regards improvement as only temporary and dependent upon the mental impression, and Agnew

positively states²⁴ "traumatic epilepsy is practically incurable by surgical operation," though he admits there are cases on which internal medication exercises no controlling influence that may with great propriety be subjected to operation and cites the one hundred and two cases collected by O. Laurient²⁵ with 54% cured. But, he says—and too much emphasis cannot be laid upon it—it is not too much to assume that surgery is responsible for the great majority of traumatic epilepsies, because of poor treatment at time of injury—the doctrine that depressed fractures of the skull without symptoms require no operative treatment being responsible for many unfortunate sequels. I quote his own words: "However small may be the depression which follows a fracture of the cranium, save in one or two localities, it will encroach enough upon the dural nerves to cause more or less irritation, which, though insignificant at first, and not at all recognizable to the consciousness of the patient, yet eventually that irritation will be propagated to the cortex and brain ganglia until finally the paroxysmal explosion occurs. * * * * Whenever, therefore, in my judgment, the profession can accept the doctrine that *all depressed fractures of the cranium, however slight may be the depression, and entirely irrespective of pressure symptoms, are proper subjects for trephining*, then will traumatic epilepsy largely disappear."

Jacksonian Epilepsy. In cases of limited epilepsy, or whenever the convulsion invariably begins in the same muscle or group of muscles, exploratory trephining is surely indicated, though as yet cases are too few and results too unstudied to warrant any definite promise of success. Parkes, of Chicago, warmly recommended operation, and others have been equally enthusiastic.

TUBERCULAR MENINGITIS.

Here is a disease wholly incurable by any method thus far devised. Some months ago I wrote:²⁶ "It is not unlikely that the time will come when we will boldly open the skull and wash out the meningeal spaces in cases of tubercular meningitis, as we do the belly in tubercular peritonitis. The peculiar disappearance of the tubercular process in peritonitis treated by flushing the abdomen leads to the inevitable conclusion that a similar result may be anticipated in the analagous condition, tubercular meningitis, especially when complicated with hydrocephalus."

Scarcely a week had passed when I was called upon to operate. I immediately addressed letters to Profs. Senn, of Chicago, and Keen, of Philadelphia, asking if operation were justifiable. The one replied: "I would tap with a small trocar under strictest antiseptic precautions and inject two drachms of ten per centum iodoform glycerine emulsion and repeat as often as necessary"—practically the same treatment that has proven so successful in tuberculosis of joints; the other advocated open

ing the skull, tapping the ventricles, irrigation and drainage. But the patient died before receiving their replies and I was probably spared the necessity of adding a third fatal case to my list. It does seem to me, however, that something may be done in a surgical way for these fatal cases.

MICROCEPHALUS.

Last year Lannegoue, of Paris, proposed an operation for the relief of idioex dependent upon microcephalus, believing the deficient cerebral development to be the result of premature closure of the fontanelles and sutures. This operation, which he calls *craniectomy*, he has performed twenty-four times with varying degrees of success. Keen has also operated in one case with marked improvement—but he believes simple trephining will accomplish as much as the more formidable linear craniectomy. Wyeth, of New York, has done the linear operation four times with two deaths and marked improvement in one case. Van Lennep, of Philadelphia,⁸⁷ has operated twice—one child died three days after operation; the other (a boy five years old) has improved slightly. McClintock, of Topeka,⁸⁸ has made one operation with very decided improvement. Other men have operated without death but it is too early to report as to success or failure.

Two cases have been operated upon in Kansas City, one by Dr. J. F. Binnie and one by myself. Both children died from shock. The history of my operation is as follows:

Case.—Lydia H—, aged 11 years, patient of Dr. John Punton. Was hurt when about eighteen months old by a fall; picked up in an unconscious state. It was found that her right knee was injured. Convulsions occurred for some time after the injury. Condition of knee grew worse. At age of five had scarlet fever, causing otitis media of left side, which was cured after some months. Though lame she at 7 years went to school and began to learn to read. Soon after she had a severe spasm repeated at frequent intervals for 48 hours and timed that time convulsions have been more or less frequent—at first at quite long intervals but gradually increasing in frequency and severity until the average is from 22 to 30 each week. In 1888 she lost her speech and has not spoken since; this was accompanied by paralysis of left side. In 1889 leg was amputated for tumor albugi; since operation left ear has again discharged but hearing in right ear is good. Case came under care of Dr. Punton one year ago and was placed on large doses of bromide which seemed to control spasms at first, but the action seemed as bad as before. She was greatly emaciated, but upon discontinuance of bromides under tonics and forced feeding has much improved physically.

I first saw the case Oct. 18, 1891 and made the following note: "Patient well developed physically; head unusually small and unenlarged; occiput being very prominent, especially on right side; face blank and expressionless, eye bright and of the peculiar staring and restless character so often noticed in microcephalic children; pupils much dilated; discharge from left ear; speechless; pays very little attention to what is said or done; has upon floor and playability (she hears it is said) with little pieces of wood; passes urine and feces in diaper apparently without notice; has to be fed—in fact leads a purely vegetative life. Is said to be irritable and vicious, *i. e.* liable to harm others if not watched. At times

is said to be much brighter, but for weeks at a time will seem to be oblivious to surroundings—at such times is apt to have many convulsions."

Nov. 1, 1891, assisted by Drs. Eggers and Puntton (Drs. Burnett and Thrush also present) I opened the skull upon the left side, over the Rolandic fissure and the speech center; there was some bulging of the dura, and no impulse. Upon opening the meninges, suspecting a cyst, I pushed an aspirating needle an inch into the brain and withdrew six drachms of serous fluid; the needle was followed down with a bistoury, a free opening made and drainage established. The dura was brought together with one or two sutures and the scalp closed with continuous suture except at point of drainage. The scalp was then reflected from the right side, and a linear craniectomy made, the opening being $\frac{3}{4}$ in. wide by $4\frac{1}{2}$ in. long. The dura was opened to permit inspection over the motor areas. There was distinct cloudy infiltrate in the pia mater with adhesions to the convolutions in the arm and leg centers; the opening was enlarged with Rongeur forceps because of *extreme* tension over motor areas; the adhesions were broken up, wound irrigated, dura closed, drainage tube to dura, and scalp closed. Duration of operation one hour and forty minutes.

Patient was put to bed with profound shock—from which she never rallied. Upon recovering from the anæsthetic, there was a look of brightness and intelligence about the face that made the friends exclaim: "That change is enough to justify any operation." But in spite of vigorous measures she died at the end of 42 hours.

Autopsy.—Nov 4, 1891. *Post mortem* examination held fifteen hours after death. Present: Drs. John Puntton, J. T. Eggers, J. N. Jackson and Emory Lanphear. Rigor mortis well marked. Wounds in good condition. Upon removing calvaria pachymeningitis of long standing exhibited everywhere. Right brain much smaller than left and whole far smaller than normal; brain paler than natural. Sinuses empty but vessels of pia much injected. Chronic inflammation of pia extensive. Dissection of brain revealed a cyst a little larger than a pigeon's egg in the speech convolutions a half inch below surface and encroaching upon second frontal convolution. It was surround by a somewhat softened condition of the white substance and walls of cyst were very thin. Frontal gyri not well developed.

Here was a case that promised something, and I am sure had life been preserved that there would have been some improvement, although speech probably could never have been restored; though what the developmental process might have brought forth is problematical.

I certainly cannot agree with Bremer that linear craniectomy for microcephalus is a bad operation. Of course where there is a primary lack of cerebral development, closure of sutures being secondary, nothing can be expected from surgery; but there can be absolutely no doubt that some cases of defect in mental development are secondary to premature closure of the skull, and in such craniectomy is certainly not only justifiable but promises success in at least a moderate percentage of cases. So far as I can learn the primary mortality is about 11%.

METHOD OF OPERATION.

Whenever possible the head is shaved on the day before operation and an antiseptic dressing applied after careful scrubbing with soap and water. When the patient is anæsthetized (chloroform *always* being employed because of contracting cerebral vessels and less liable to induce

vomiting), the scalp is thoroughly scrubbed with brush, soap and water, dried and washed with ether and then with bichloride solution — 1 to 1000. At this point $\frac{1}{4}$ grain morphine may be advantageously injected hypodermically. A row of sutures are run "back-stitch" around the field of operation, to control bleeding from the scalp. A large flap is made, the cut being clean and carried through the periosteum; a silk suture may be run through this flap as it is reflected and given to an assistant to hold. The method of entering the skull varies according to the habits and skill of the operator. Personally I prefer the Galt trephine for fractures and the like, but for extensive opening I use the gouge, Rougeur and mallet and chisel. In twenty-three operations I have never seen any bad effects follow their use unless it be in the last case reported. Too heavy blows may of course produce shock, as Agnew has pointed out, but by not too vertical position and with gentle taps the skull can be opened far more safely than with the trephine. If the primary opening is found to be too small it may be enlarged with the Rougeur. If one desires to replace the chips they are put in a mild bichloride solution of a temperature of 105° F. and when ready are put back upon the dura in a kind of mosaic; these will grow to their places again, as practiced by Macewen, Adamkiewicz and others; or we may fill the cavity with decalcified bone chips after the manner of Senn, or even transplant from the goose, as in Jacksch's celebrated case. But I cannot see any special advantage in this (except in cases of extensive traumatism where a large part of the brain is exposed or in operation for neoplasms) as in operative cases we usually wish to remove intracranial pressure; besides, the opening is so promptly and satisfactorily filled with fibrous tissue that it is useless trouble, and the pieces *may* act as a foreign body.

The incision through the dura may be crucial or preferably made to follow the line of incision through the bone about one-eighth of an inch from the margin and extending three-fourths around the circumference. The meningeal arteries may be caught with forceps and tied with fine gut as anywhere else in the body. Hæmorrhage was formerly greatly feared. Indeed four years ago when I accidentally cut the superior longitudinal sinus I did not know how to control the bleeding so I clasped it and the bone in a pair of forceps and left the latter *in situ* for four days—with recovery; it was a case of gunshot wound and not included in this list of cases. But now we have learned that the sinus can sometimes be tied, and if not, hæmorrhage can be checked by packing with iodoform gauze; even in rupture of the lateral sinus this expedient has repeatedly proved efficient. For tying vessels of the meninges and brain I employ juniper-oil gut, carefully prepared and softened. Bleeding from the diploë gave me much trouble in my earlier operations and the use of wax, etc., was unsatisfactory and unscientific; now I simply punch the bleeding points with the handle of some convenient instrument or even crush the bone if necessary. For small vessels in the substance of the brain hot water

irrigation usually suffices; but if persistent they may be touched with the tip of the Paquelin cautery or the wound packed with iodoform gauze. As the arteries which supply the brain itself are terminal, every vessel should be scrupulously maintained if possible; many times, as Horsley has shown, they can be lifted out of the sulci and preserved.

Hot water (115°F.) previously boiled, should be at hand to check bleeding, and furthermore for the purpose of douching the wound and head when symptoms of collapse appear. It has a wonderful effect in restoring the pulse and preventing shock.

In operating for tumor, if the growth does not present by simple inspection palpation may detect it, and if not the cortical substance may be cut through and the incision carried into the white substance. Such incision must be vertical and directed into the corona radiata, avoiding when possible injury to other fibers, especially those going to the internal capsule. The gap in the brain caused by the removal of a tumor rapidly fills by eversion of the cut corona radiata and by granulation tissue if large.

When the work has been done the wound is carefully irrigated and the flap of dura turned back into place. I always suture the dura with finest catgut, unless there be some strong contra-indication. Few cases require a drain through the dura. A few strands of gut or a small drainage tube may be placed under the scalp, iodoform dusted in, the scalp sewed and the wound dressed as any simple cut.

Shock is one of the great drawbacks to cerebral operations. In one of my two fatal cases death undoubtedly occurred from this cause. Whenever possible the patient should have a rest in bed for several days before operation (unless very robust) with stimulants and forced feeding. At the time of operation Champonière advises one-tenth of a grain of sulphate of strychnine hypodermically when the patient is fully under the influence of the anæsthetic. After operation the head must be kept low, the body very warm and the usual remedies for shock (alcohol, digitalis, etc.) employed. The after treatment is the same as that of any other capital operation.

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